

**UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
RENTON, WASHINGTON 98057-3356**

In the matter of the petition of

**Embraer Empresa Brasileira de Aeronáutica
S.A. (Embraer)**

Regulatory Docket No.FAA-2002-13021

for an exemption from § 25.901(c) of Title 14,
Code of Federal Regulations

GRANT OF AMENDED EXEMPTION

By letter dated September 22, 2010, Mr. Ricardo Lavall Hollerbach, Embraer Empresa Brasileira de Aeronáutica S.A. (Embraer), Av. Brigadeiro Faria Lima, 2170, 12227-901 – S. José dos Campos – SP, Brazil, petitioned for an amendment to exemption no. 7933, to provide exemption from the “no single failure” criteria of § 25.901(c) of Title 14, Code of Federal Regulations (14 CFR) as it relates to uncontrollable high-thrust failure conditions. Recent studies and service experience indicate that some existing transport category airplanes do not strictly comply with § 25.901(c) for certain uncontrollable high thrust failure conditions. The proposed exemption, if granted, would permit type certification of similarly non-compliant Embraer Model EMB-135BJ series airplanes to allow installation of Rolls-Royce (RR) AE3007A2 series engines, and subsequent RR AE 3007A series engines.

The petitioner requires relief from the following regulations:

Section 25.901(c) as amended by Amendments 25-1 through 25-84:

(c) For each powerplant and auxiliary power unit installation, it must be established that no single failure or malfunction or probable combination of failures will jeopardize the safe operation of the airplane except that the failure of structural elements need not be considered if the probability of such failure is extremely remote.

Additional requirements as per Issue Paper G-1 originated from the significant major modification presented in the DCA 0145-000-00020-2008 “EMB-135BJ Performance Enhancements.”

The petitioner supports its request with the following information:

This section quotes the relevant information from the petitioner's request. The complete petition is available at the Department of Transportation's Federal Docket Management System, on the Internet at <http://regulations.gov>, in Docket No. FAA-2002-13021.

Embraer respectfully submits the enclosed Petition for an exemption for the EMB-135BJ model with the modifications presented in the DCA 0145-000-00020-2008/FAA, herein called EMB-135BJ Enhanced, from the no single failure requirements of 14CFR §25.901 (c) as it relates to uncontrollable high thrust failure conditions.

Embraer proposes to amend the FAA Exemption no. 7933 granted to EMB-135BJ equipped with engine AE3007A1E from requirement 14CFR §25.901 (c) for the EMB-135BJ Enhanced equipped with the AE3007A2 engine.

Grounds Supporting Exemption

The EMB-145XR and EMB-135BJ, previous models of the Legacy Enhanced, have received partial exemption of compliance with the requirement since there were three scenarios, all of them on ground, not successfully demonstrated to be entirely in accordance with the requirement. FAA have granted exemption to these models through Exemptions No. 7908 (October 21, 2001, for EMB-145XR) and No. 7933 (December 12, 2001 for EMB-135BJ).

The EMB-135BJ Enhanced is equipped with Rolls-Royce AE3007A2 engines, a modification over the previous engine model, the AE3007A1E. This engine modification consists of a new fan module with fewer fan blades (22 instead of 24 on A1E) and new spinner among other components of fan module. [Refer to Docket No. FAA-2002-13021 in the Federal Docket Management System to view a graphic Embraer provided, which illustrates the main differences between A1E and A2 engines.]

All the rest of the engine is maintained the same as the A1E engine, including compressor, combustion chamber, turbines, exhaust, FPMU (Fuel Pump and Metering Unit) & FADEC hardware. FADEC software is being updated to receive A2 thrust tables among other modifications/improvements.

The AE3007A2 engine Max TO (Take Off) thrust (9022 lbf) has increased about 14%, comparing to the AE3007A1E (7974 lbf) engine currently used on EMB-135BJ, but the maximum peak thrust during a MMV (Main Metering Valve) position failure (fully open) in the AE3007A2 is 10,501 lbf, against the 10,150 lbf.

Aircraft handling qualities analysis for the Uncontrollable High Thrust (UHT) scenarios (MMV fully open), for the EMB-135BJ with AE3007A2 engines showed that with the additional thrust increase (3.5%), the results are similar to the ones obtained with

AE3007A1E engines. Small differences were found between the required flight control surfaces deflections for the EMB-135BJ (Legacy 600) and EMB-135BJ Enhanced (Legacy 650) (less than 1 degree) and the deflections are far from any detent. Therefore, all UHT analysis results from the EMB-135BJ with AE3007A1E engines are applicable to the EMB-135BJ with AE3007A2 engines.

The UHT protection logic and corrections implemented in the EMB-145 family FADEC since first certification have shown positive results with almost 13 million flight hours accumulated with no safety issues since the last UHT event in 2003. AE3007A2 FADEC is inheriting all EMB-145 family FADEC improvements and corrections implemented during its history.

During a meeting held during May 2010 at FAA facilities in Seattle with FAA, Embraer and Rolls Royce it was discussed that the existing exemption should be amended and stay valid for a period of four years after FAA validation. During this period, Embraer and Rolls-Royce will develop and make available improved UHT logic which will shutdown engines on the ground only upon detecting high N1 and with a TLA command at or less than idle. This improved UHT logic is the only known practical action (cost beneficial and technologically feasible) to address the scenarios exempted by the memo, in order to minimize the adverse effects on safety associated with granting exemption from 14CFR §25.901 (c) for the EMB-135BJ Equipped with AE 3007A2 engines.

No later than four years from the granting of Amendment A to this Exemption (i.e. Exemption # 7933A), for all airplanes EMB-135BJ to which this exemption applies, Embraer must:

- (a) obtain FAA approval of amended type designs incorporating thrust malfunction detection and accommodation logic that protects against all noncompliant uncontrollable high thrust failures on ground, except for those due to failures within the airplane throttle system;
- (b) assure all new EMB-135BJ model production airplanes are equipped with the amended type designs of item (a) or subsequently approved thrust malfunction accommodation logic; and
- (c) obtain FAA approval of service instruction to facilitate retrofit of all existing EMB-135BJ model airplanes with the amended type designs of item (a) and/or any subsequently approved thrust malfunction accommodation logic.

Based on the above considerations Embraer respectfully proposes to amend the exemption granted by document (FAA Exemption no. 7933), from the requirement of 14CFR §25.901 (c), for the EMB-135 BJ (Legacy Enhanced) equipped with the AE3007A2 engines.

Federal Register publication

A summary of this petition was published in the *Federal Register* on November 8, 2010. The FAA received no comments.

The FAA's analysis

In the process of evaluating the Embraer Model EMB-135BJ Design Change Application (DCA) 0145-000-0020 the FAA has determined all practical actions had not been taken within the scope of that change to eliminate or further reduce the risks as required by Condition 1 of the original exemption 7933, as granted on December 12, 2002. Specifically, while a major engine-control software change was undertaken, thrust-malfunction-accommodation logic (i.e. logic that identifies and safely accommodates any sustained, substantial discrepancy between the actual and commanded thrust, as sensed and validated by the engine control) was not incorporated. Such thrust-malfunction-accommodation logic has been found to be practical and effective at eliminating all noncompliant, uncontrollable, high-thrust failures except for those associated with failures within the airplane throttle system (e.g. stuck throttle, disagreement between actual throttle position and that input to the engine control, etc.).

Embraer requests an amendment to the original exemption no. 7933 to allow them up to 4 years from the date of granting to develop, certificate, put into production, and facilitate retrofit of acceptable thrust-malfunction-accommodation logic, eliminating all noncompliant, uncontrollable, high-thrust failures, except for those due to failures within the airplane throttle system. To that end, in amending exemption 7933 to 7933A, limitation number 4 (see below) is added to the conditions and limitations of this exemption amendment.

Conclusion

In consideration of the foregoing, I find that a grant of exemption is in the public interest and will not adversely affect safety. Therefore, pursuant to the authority contained in 49 U.S.C. 40113 and 44701, delegated to me by the Administrator, Embraer Empresa Brasileira de Aeronáutica S.A. (Embraer) is granted an exemption from § 25.901(c) to the extent necessary to allow type certification of the Model EMB-135BJ series airplanes with RR AE3007A1E and subsequent RR AE3007A series engines, and AE3007A2 series engines, without an exact showing of compliance with the requirements of § 25.901(c) as they relate to single failures resulting in uncontrollable high-thrust conditions. For the Model EMB-135BJ series airplanes, this exemption is subject to the following conditions and limitations:

1. Embraer must demonstrate, in accordance with an FAA-approved "Airworthiness Assessment and Risk Management Plan," that all practicable actions have been taken to minimize the adverse effects on safety associated with granting this petition. These must include, but are not limited to, practical actions to eliminate or further reduce the risks by improving designs, procedures, training and instructions for continued airworthiness.

2. Embraer must demonstrate, in accordance with an FAA-approved “Airworthiness Assessment and Risk Management Plan,” that the risks associated with exempting the “uncontrollable high-thrust failure condition” from the single failure provisions of § 25.901(c) are no greater for the proposed Model EMB-135BJ series airplanes with RR AE 3007A1E series engines than those generally known to exist for comparable airplanes within the current transport fleet. Acceptable risk for this provision can be characterized as:

- a. The airplane complies with § 25.901(c) for any foreseeable uncontrollable high-thrust failure conditions in flight and on the ground, except possibly during takeoff and landing touchdown; and
- b. The expected frequency of occurrence of the uncontrollable high-thrust failure condition is less than once per ten-million airplane operating hours.

3. The following “Note” will be added to the airplane Type Certification Data Sheet for any airplane certificated under this exemption:

The FAA has concluded that the occurrence of any uncontrollable high-thrust failure condition, or any of the associated causal failures listed within Embraer Document (reference TBD) are reportable under §§ 121.703 (c), 125.409 (c), and 135.415(c).

In support of this “Note,” Embraer must develop and obtain, prior to customer delivery, FAA approval of the Embraer document referenced in the “Note.” This document lists those failures that can contribute to or cause an uncontrollable high-thrust failure condition covered by this exemption. This document will then be made available as part of the instructions for continued airworthiness. Further, the failures listed within this document will be added to the list of reportables under § 21.3 for any airplane certificated under this exemption.

4. No later than four years from this granting of amendment A to exemption no. 7933, for all airplanes to which this exemption applies, Embraer must:

- a. Obtain FAA approval of amended type designs incorporating thrust-malfunction-accommodation logic that eliminates all noncompliant, uncontrollable, high-thrust failures, except for those due to failures within the airplane throttle system;
- b. Show that all new Model EMB-135BJ production airplanes are equipped with the amended type designs approved to satisfy condition 4a or any subsequently approved thrust-malfunction-accommodation logic; and

c. Obtain FAA approval of service instructions to facilitate retrofit of all existing Model EMB-135BJ airplanes with the amended type designs approved to satisfy condition 4a or any subsequently approved thrust-malfunction-accommodation logic.

5. The granting of this exemption does not relieve any regulatory obligation to identify and correct unsafe conditions related to uncontrollable high-thrust failure conditions.

Note: Additional background and guidance regarding these provisions are provided in FAA Letter 02-112-02, dated October 19, 2001.

Issued in Renton, Washington, on **FEB 7 2011**

A handwritten signature in blue ink, appearing to read "Jeffrey E. Duven".

Jeffrey Duven
Acting Manager, Transport Airplane Directorate
Aircraft Certification Service